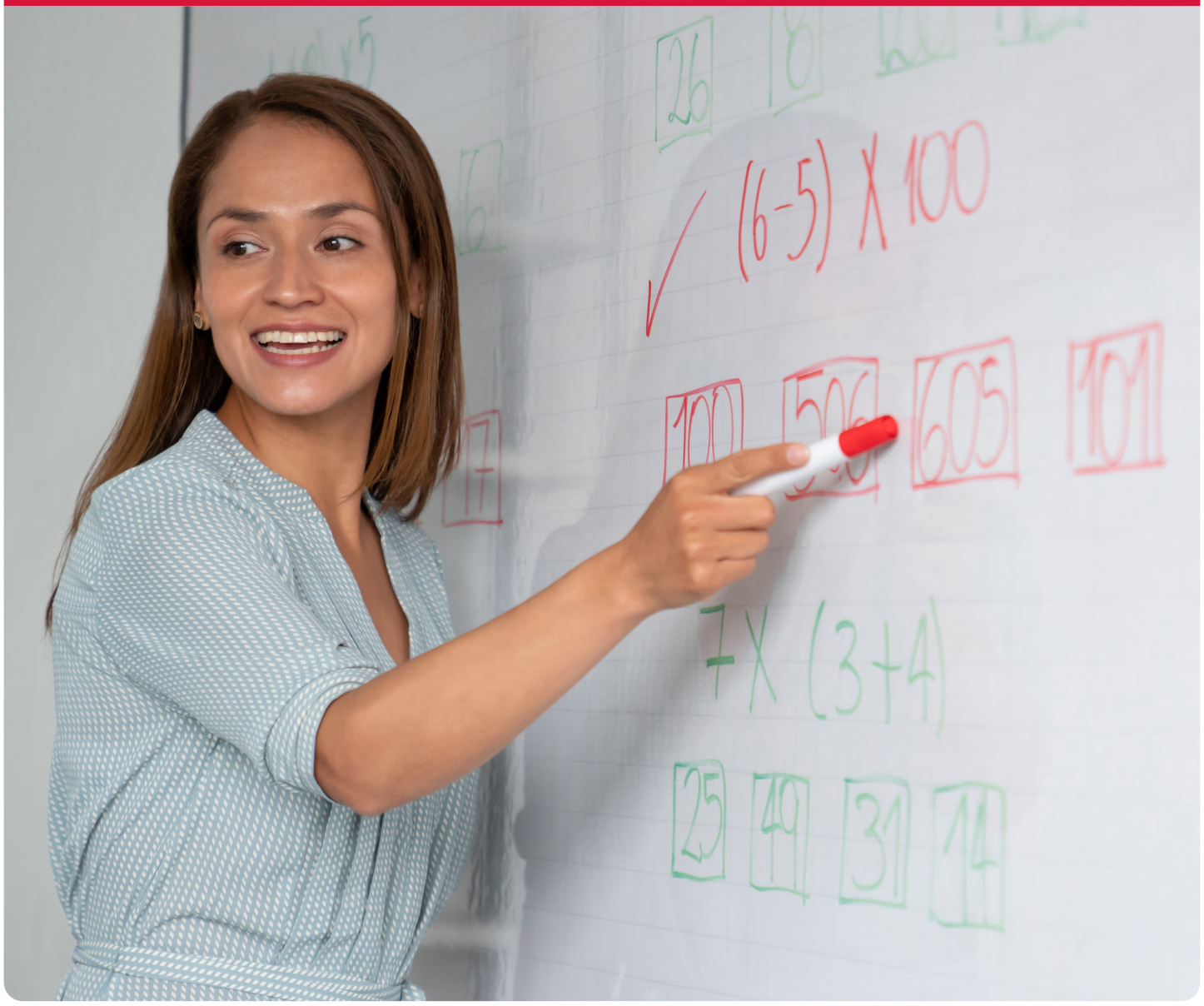
NSW Department of Education

Primary mathematics specialisations in initial teacher education

2022 evaluation report

Centre for Education Statistics and Evaluation



September 2023

NSW GOVERNMENT

Centre for Education Statistics and Evaluation

The Centre for Education Statistics and Evaluation (CESE) undertakes in-depth analysis of education programs and outcomes across early childhood, school, training, and higher education to inform whole-of-government, evidence-based decision-making. Put simply, it seeks to find out what works best. Its focus is all education in NSW. CESE's main responsibilities within the department are:

- qualitative and quantitative research, including data analysis, evidence papers and case studies that build understanding and uptake of evidence-based practice
- robust data collection to enable research and statistics for the education and training sector
- evaluating key policies and programs to strengthen quality delivery and student outcomes
- national engagement on research agenda and data strategy
- driving capability uplift in the use of data and evidence as part of everyday practice
- trialling innovative initiatives to improve student outcomes.

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We acknowledge the homelands of all Aboriginal people and pay our respect to Country.

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List of acronyms

ATAR	Australian Tertiary Admission Rank
CESE	Centre for Education Statistics and Evaluation
EFTSL	Equivalent full-time student load
ITE	Initial teacher education
KLA	Key learning area
LMS	Learning management system
NESA	NSW Education Standards Authority
NSW	New South Wales
TEDS-M	Teacher Education and Development Study in Mathematics

Executive summary

What did we evaluate?

The provision of primary mathematics specialisations, to improve mathematics content and pedagogy training in primary initial teacher education courses, is an initiative of the NSW Mathematics Strategy. The NSW Education Standards Authority (NESA) has investigated and endorsed primary teaching specialisations offered by universities in NSW. These specialisations are suites of study units available to students studying for a primary teaching degree. The mathematics specialisations aim to develop initial teacher education (ITE) students' mathematics pedagogical knowledge, their understanding of relevant and emerging mathematics technologies and practices, and their confidence in using various effective teaching approaches. The NESA-recognised specialisations were first offered at the University of Sydney in 2016 and are now available at 8 universities in NSW.

This evaluation sought to answer the following questions:

1. Have the primary mathematics specialisations been implemented effectively in initial teacher education settings?
2. Do primary mathematics teachers with a specialisation demonstrate greater content and pedagogical knowledge and confidence in teaching maths?

How did we evaluate it?

The Centre for Education Statistics and Evaluation (CESE) surveyed ITE students of primary education at 6 universities that offered NESA-recognised specialisations in mathematics in 2020 and 9 universities in 2021. This report presents the findings from both ITE surveys. We supplement this with findings from interviews we conducted with ITE students and academic staff implementing the NESA mathematics specialisations. We also report administrative data on students who have graduated with a NESA mathematics specialisation.

What did we find?

We found that half of the initial teacher education students surveyed were aware of the NESA-recognised mathematics specialisations. Currently, there are 8 universities that offer the specialisations as part of their bachelor (undergraduate) degree programs and 2 that offer the specialisations within a master's (postgraduate) degree program. We interviewed 9 students who were currently enrolled in undergraduate primary education degree programs and had chosen a specialisation. Of these students, 4 were unaware that specialisations could be 'NESA-recognised'.

Survey data collected from initial teacher education students demonstrates that students who reported greater interest in mathematics were more likely to undertake a mathematics specialisation pathway when it was offered to them. This was confirmed during interviews with mathematics specialisation students, who believed that the pathway would offer opportunities for them to contribute their expertise to mathematics planning and programming within a school context.

We asked initial teacher education students to rate the structure and coherence of their degrees and found that on average, mathematics specialisation students reported their degrees to be more coherent and appropriately structured to support their understanding of mathematics education pedagogy.

We also interviewed initial teacher education course coordinators at 6 universities that offered mathematics specialisations. They noted that the process of attaining accreditation for their initial teacher education degrees and NESA-recognised specialisations was straightforward. They also noted that there had been recent increases in enrolments in the mathematics specialisations. This is also reflected in the increased number of primary mathematics specialisation graduates who have been placed in NSW public schools in the last 2 years.

We found that students who were undertaking primary mathematics specialisations reported being able to apply their mathematics knowledge more readily while on their professional experience placement. While this is a positive finding, we are unable to determine if this is due to the specific mathematics education and pedagogy content offered by the mathematics specialisations.

What are the implications of these findings?

Several conclusions can be made from the results of our analysis. ITE providers should continue to find ways to improve general awareness levels of the NESA mathematics specialisations among students in primary education degrees. There could also be greater emphasis placed on the purpose of the specialisations and career pathways available to students who complete them. ITE providers may also consider giving students more opportunities to participate in practical activities to apply their specialist mathematics knowledge.

The NSW Department of Education should continue to support NESA mathematics specialisation graduates' placement in schools and provide clarification to both schools and teachers about how to best support new mathematics specialisation graduates and share their content knowledge once they are in a classroom teacher position.

Introduction

Background

In October 2018 the NSW Government announced the NSW Mathematics Strategy,[1] made up of 10 initiatives to support the teaching and learning of mathematics in NSW public schools. The vision of the strategy is that every child in NSW develops the necessary mathematics skills they need to succeed in life. The strategy was announced amid several challenges in mathematics education, including non-universal participation in Stage 6 mathematics and declining performance in international assessments (Wilson and Mack 2014; Jaremus et al. 2019).

Several authors have suggested that these challenges could be addressed by improving the quality of mathematics teaching at the primary level (Blackley and Howell 2015; Teacher Education Ministerial Advisory Group 2014). Higher mathematics knowledge of teachers is associated with increased confidence to teach mathematics (Beswick and Goos 2012; Norton 2017), which is expected to improve student engagement in mathematics. However, one of the hurdles to improving mathematics instruction at the primary level is the generalist nature of primary teaching degrees. Research in NSW (BOSTES 2016) found that primary teaching degrees:

- varied in the mathematics units required for completion
- offered fewer mathematics units, which may not provide students with enough practice and preparation to address the continuum of learning across the whole of the primary syllabus
- lacked consistency in the use of technology in teaching mathematics.

An underpinning initiative of the NSW Mathematics Strategy is the improvement of initial teacher education (ITE) in mathematics for primary teachers through the provision of primary mathematics specialisations. Primary mathematics specialisations have been identified as a potential solution to address mathematics preparation concerns in primary teaching settings (Teacher Education Ministerial Advisory Group 2014). The NSW Education Standards Authority (NESA), in collaboration with the NSW Department of Education (the department), assesses and approves applications from universities that seek to implement and offer mathematics specialisations within their primary teaching degrees. The University of Sydney was the first institution to have NESA approve their mathematics specialisations in 2016, with the first cohort of specialised graduates being appointed to teach in 2018. As of 2022, there are 8 ITE providers that offer NESA mathematics specialisations as part of their primary teaching programs.

This initiative aims to contribute to the following outcomes of the NSW Mathematics Strategy:

- NSW public schools have more specialist mathematics teachers
- teachers of mathematics have improved access to, and participate in, quality professional learning opportunities for teaching mathematics
- teachers of mathematics feel more confident in teaching mathematics.

1 For more information, visit NSW Mathematics Strategy 2025.

NESA-recognised specialisations

The NESA-recognised mathematics specialisations are suites of study units that students can voluntarily enrol into as part of their primary teaching degrees. The requirement for a primary mathematics specialisation recognised by NESA (NSW Education Standards Authority 2018) is:

- a total of at least 6 units (0.75 equivalent full-time student load (EFTSL)) of discipline and/or discipline-specific curriculum and pedagogical studies in an undergraduate program, or
- at least 3 units (0.375 EFTSL) of discipline and/or discipline-specific curriculum and pedagogical studies in primary mathematics in a graduate-entry program building on at least 4 units (0.5 EFTSL) of discipline studies in the underlying bachelor degree related to the mathematics key learning areas (KLAs)–for example:
  - pure or applied mathematics
  - other studies of mathematics that are relevant to the central concepts, modes of inquiry and structure of the content/discipline(s) (only one unit of statistics may be counted)
  - engineering units may be considered upon review of unit statements for appropriate mathematical content.

The study units are intended to:

- reflect the careful and deliberate scaffolding of mathematics discipline studies, curriculum, and pedagogical studies
- develop comprehensive discipline-specific curriculum and pedagogical knowledge relevant to the NSW Mathematics K–10 Syllabus, with specific emphasis on Early Stage 1 and Stages 1 to 3, and complex aspects of mathematics
- equip teacher education graduates with a deep understanding of the processes and relevant emerging technologies and practices specific to mathematics, and support graduates to gain confidence in the complex aspects of mathematics
- equip graduate teachers to be competent and confident users of a range of effective teaching approaches that foster school student inquiry, innovative thinking and student confidence in conducting investigations, working mathematically and solving mathematical problems.

NESA-recognised mathematics specialisations are currently offered at the following initial teacher education providers.

Table 1

Accredited teaching degrees featuring NESA-recognised mathematics specialisations

ITE provider	Program
Charles Sturt University	Bachelor of Education (Early Childhood and Primary) Bachelor of Education (K–12) Bachelor of Education (Early Childhood and Primary) [Graduate entry] Master of Teaching (Primary)
Southern Cross University	Bachelor of Education (Primary)
University of New England	Bachelor of Education (K–6 Teaching) Bachelor of Education (K–12 Teaching)
University of Newcastle	Bachelor of Education (Primary)
University of Notre Dame (Australia)	Bachelor of Primary Education Master of Primary Teaching
University of Sydney	Bachelor of Education (Primary)
University of Wollongong	Bachelor of Primary Education Bachelor of Primary Education (Honours) Bachelor of Primary Education (Dean's Scholar)
Western Sydney University	Bachelor of Education (Primary) Master of Teaching (Birth – 5 Years / Birth – 12 Years) Master of Teaching (Primary)

Note: There are 2 universities that previously offered a NESA-recognised specialisation but are not currently offering it: the University of Technology Sydney stopped offering a primary teaching degree in 2021, and Macquarie University is no longer offering their primary mathematics specialisation.

Evaluation aims

The mathematics specialisations aim to develop initial teacher education students' mathematics pedagogical knowledge, their understanding of relevant and emerging mathematics technologies and practices, and their confidence in using various effective teaching approaches. This evaluation sought to answer the following questions:

- Have the primary mathematics specialisations been implemented effectively in initial teacher education settings?
- Do primary mathematics teachers with a specialisation demonstrate greater content and pedagogical knowledge and confidence in teaching maths?

Method

We used a mixed-methods design, which included analysis of survey and interview data collected from students in primary education degrees, to understand students' awareness of the mathematics specialisations and their perception of how mathematics education and pedagogy content was covered in their degrees. We also interviewed academics from universities that offered specialisations to understand how the mathematics specialisations were being implemented.

Data

We surveyed ITE students of primary education at 6 universities that offered NESA-recognised specialisations in mathematics in 2020 and 9 universities in 2021. This report presents the findings from both ITE surveys, comparing the results across the 2 survey waves. We supplement this with findings from interviews conducted with ITE students and academic staff implementing NESA mathematics specialisations. We also report administrative data on students who have graduated with a NESA mathematics specialisation.

Surveys

The ITE student survey was distributed by universities via email as an anonymous link to students undertaking a primary teaching degree. Respondents were asked to indicate if they were undertaking a mathematics specialisation or not. The survey questions covered:

- students' awareness of the NESA primary mathematics specialisations
- drivers and barriers to entering the primary mathematics specialisations
- content of students' initial teacher education course.

The 2020 survey wave was open from 14 October to 4 November 2020. We cleaned the completed responses, removing incomplete and non-genuine responses from the data. A total of 94 responses were received for this survey, including 13 primary mathematics specialisation students.

The 2021 survey wave was open from 5 October to 4 November 2021. We cleaned the survey data, removing incomplete and non-genuine responses. A total of 594 completed responses were collected for this survey, a notable increase from 2020, and 121 (20.4%) respondents reported undertaking a primary mathematics specialisation. Data obtained from NESA indicates that there were 403 individuals enrolled in a recognised mathematics specialisation in 2021, which suggests that the survey response rate among primary mathematics specialisation students is approximately 30%.

Analysis

Results of the survey analysis are presented as means with 95% confidence intervals or as proportions of respondents. Where relevant, responses from students undertaking a mathematics specialisation are compared with responses from students not undertaking a mathematics specialisation.

The majority of respondents came from Western Sydney University, the University of Newcastle and the University of New England, which limits the generalisability of our findings to other universities and to the broader ITE student population. Refer to Appendix 1 for summary statistics of the characteristics of survey respondents.

Interviews

In 2021, we asked ITE students responding to our survey if they would be open to participating in an interview, and we conducted 14 interviews with ITE students. The interviews took place between 21 February and 8 March 2022. The interviews primarily covered students' awareness of specialisations in primary education degrees. Where students were completing a specialisation, they were asked about their expectations of undertaking a specialisation as well as for feedback about the specialisation itself.

We also invited academic staff who were involved with implementing a NESA mathematics specialisation at their university to provide their feedback. We conducted interviews with 10 university academics from 6 universities between 30 March and 11 May 2022. We asked about academics' experiences with the NESA accreditation process, the structure and learning activities offered as part of the specialisation, how the specialisation was communicated to students, and for general feedback about support that could be provided by the department and NESA.

We also interviewed graduate primary teachers with mathematics specialisations who were teaching at NSW public schools in 2021 as part of another initiative of the NSW Mathematics Strategy that offers support to graduate primary teachers with a mathematics specialisation. We conducted interviews in 2021 with 14 graduate teachers, 9 principals and 5 supervisors of the graduate teachers to understand the experiences of primary teachers with maths specialisations in schools and how the department can support them.

Analysis

We were unable to attain a representative sample of university students, which limits the generalisability of the interview findings. We have reported feedback from students about their experiences in the primary mathematics specialisations to provide context for the survey findings.

Table 2 outlines the representation of universities for volunteers from both the student and academic interviews. Like the survey data, student interviews largely came from Western Sydney University, the University of Newcastle and the University of New England.

There were 10 academics who responded to our invitation and agreed to participate in the interviews. These academics came from 6 different universities. Academics from the University of Sydney, the University of Technology Sydney and the University of Notre Dame Australia participated in interviews. However, there were no students from these universities interviewed.

Table 2

Representation of universities for student and academic interviews

University	Number of interviews		
	Bachelor of Primary Teaching students	Master of Teaching students	Academics
Macquarie University	–	–	0
University of New England	6	1	1
University of Sydney	–	–	1
University of Technology Sydney	–	–	2
University of Notre Dame Australia	–	–	2
University of Wollongong	–	–	0
Charles Sturt University	–	1	0
University of Newcastle	3	–	1
Western Sydney University	–	3	3

Administrative data

As part of this project, we report administrative data provided by NESA on the number of mathematics specialisation graduates who have been accredited to teach. We also report administrative department staffing data on the number of mathematics specialisation graduates who have been placed in NSW public schools.

Limitations

Survey data from initial teacher education students is not representative

We were not able to contact initial teacher education students at each of the universities directly due to privacy. As such, an anonymous link to the survey was given to each university to pass on to individuals enrolled in their primary education courses. We do not know the total number of students studying a primary teaching degree at each university, so we cannot calculate an overall response rate for both waves of the ITE survey. Furthermore, since we do not know the general demographics of the target population (age, gender and so on), we cannot determine how representative our survey sample is of the population as a whole.

Survey responses may have been influenced by unclear terminology

The survey asked ITE students if they were aware of the NESA-recognised mathematics specialisations. In many of the interviews, students at universities offering a mathematics specialisation were not aware that their specialisation was NESA-recognised. This was also apparent among other interview participants whose degrees had specific specialisation streams. For example, students undertaking a Bachelor of Special and Inclusive Education (Primary) referred to special education as their specialisation in a primary education degree. It is possible that survey respondents may not have answered this question accurately.

Few students undertaking the mathematics specialisations volunteered to participate in interviews

Students responding to the survey were asked to volunteer to participate in an interview. There were only 5 students undertaking the primary mathematics specialisations who volunteered for an interview. As such, the comments from mathematics specialisation students can only be used for descriptive purposes and are not representative of students participating in the mathematics specialisations across all initial teacher education providers.

The findings in this evaluation are primarily based on perceptions

This evaluation relies on perceptions-based survey and interview data to understand how the initiative was implemented and whether teachers with a mathematics specialisation demonstrate greater content and pedagogical knowledge and confidence in teaching maths. This evaluation does not seek to determine whether the initiative was effective at improving teacher outcomes. We expect that survey responses would be impacted by selection bias, as ITE students who select the mathematics specialisations are most likely those with higher levels of interest and proficiency in mathematics.

Implementation of the specialisations

Have the primary mathematics specialisations been implemented effectively in ITE settings?

This section explores how effectively primary mathematics specialisations have been implemented in ITE settings, in terms of students' awareness of the specialisations, students' choices surrounding their specialisation programs, and academics' perspectives on the mathematics specialisations offered by their institutions.

Key findings

- Half of the surveyed ITE students were aware of the mathematics specialisations.
- Students who reported a greater interest in mathematics were more likely to undertake a mathematics specialisation pathway.
- Students undertaking a mathematics specialisation reported that their degrees were appropriately and coherently structured.
- ITE coordinators at universities offering the specialisations noted a recent increase in enrolments.
- There has been a steady increase in the number of primary mathematics specialisation graduates in NSW public schools.

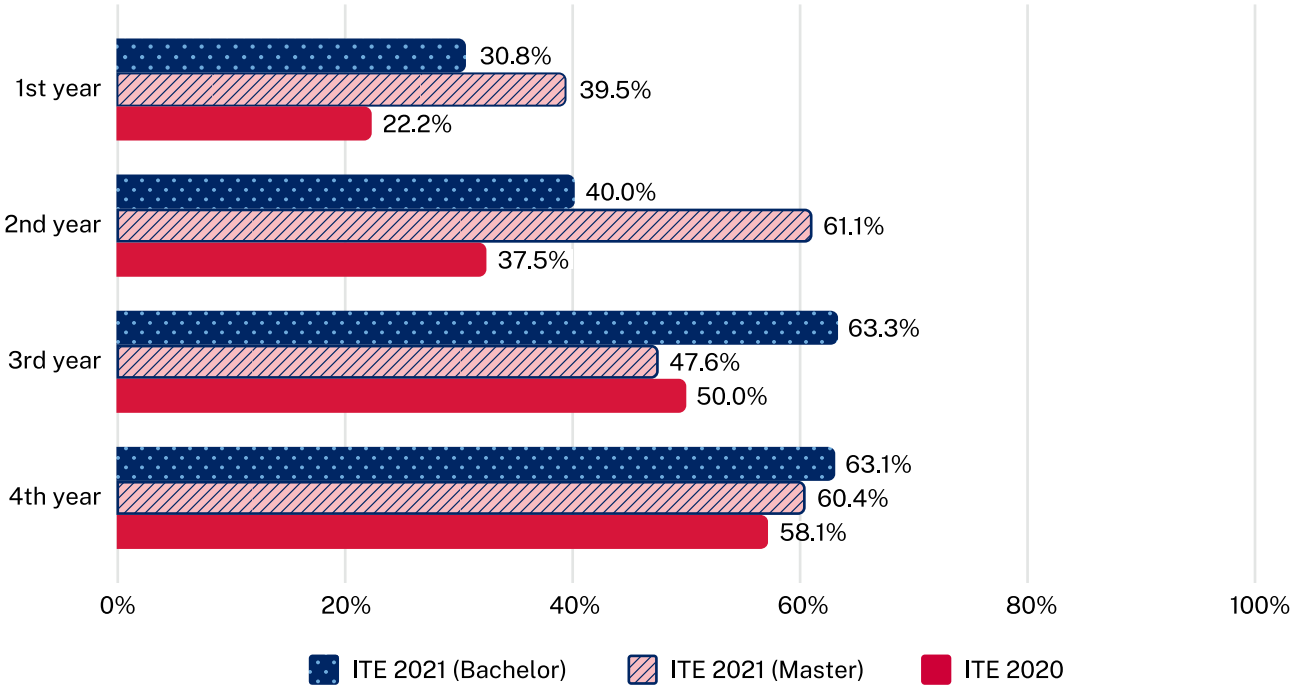
Half of the surveyed ITE students were aware of the mathematics specialisations

Around half of the surveyed ITE students reported that they were aware of the NESA-recognised primary specialisations in mathematics, with 48.9% of survey respondents being aware of the specialisations in 2020 and 51.2% in 2021. In the 2021 survey, we asked respondents who were not aware of the mathematics specialisations if they would have pursued a maths specialisation had it been available to them. A total of 63% of surveyed ITE students indicated that they would have undertaken a mathematics specialisation if they had been aware of it or if it had been offered in their primary teaching course.

Awareness of the mathematics specialisations was generally higher among respondents in the final years of their studies (Figure 1), which may reflect the different stages at which universities require initial teacher education students to undertake or select a specialisation.

Figure 1

Proportion of ITE students who were aware of the NESA-recognised mathematics specialisations, by degree stage



Note: In the 2020 survey there were 94 respondents. In the 2021 survey, 349 respondents were enrolled in a bachelor's degree and 245 respondents were enrolled in a master's degree.

CESE interviewed 9 initial teacher education students undertaking a Bachelor of Primary Teaching. These students, from the University of New England and the University of Newcastle, indicated that their universities directed them to choose a specialisation at enrolment. Of these 9 students, 5 were undertaking a mathematics specialisation, while 2 had selected special education, and the remaining 2 had selected English as their specialisation.

The 5 students enrolled in the mathematics specialisations reported consulting their course outlines for information about the required units of study to understand what the specialisations entailed, as well as receiving email communications about the specialisations. There were also 2 students from the University of Newcastle who reported receiving information from their course coordinators via presentations and emails, which outlined what was covered in the specialisations. However, 3 of the 5 students undertaking a mathematics specialisation were not aware that it was a NESA-recognised specialisation until reading about it in the survey. It is possible that the NESA-recognised status of the specialisations was relatively new and perhaps not communicated to the primary education students.

CESE interviewed 5 individuals enrolled in Masters of Teaching degrees at the University of New England and Western Sydney University. Of these 5 individuals, only one indicated an awareness of their master's course having a specialisation.

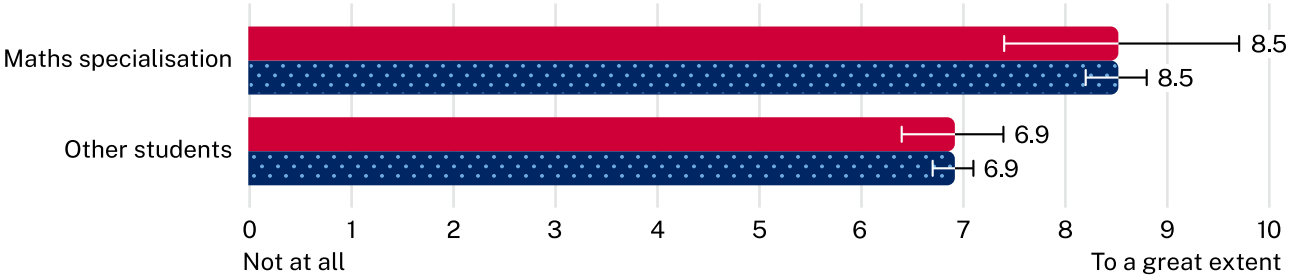
Students with an interest in mathematics were more likely to undertake a mathematics specialisation

We asked ITE students to rate how much they like teaching mathematics, how skilled they consider themselves to be at mathematics, and how much they enjoy learning mathematics. As shown in Figure 2, students enrolled in a mathematics specialisation reported higher scores across all 3 statements than ITE students who did not complete a maths specialisation.

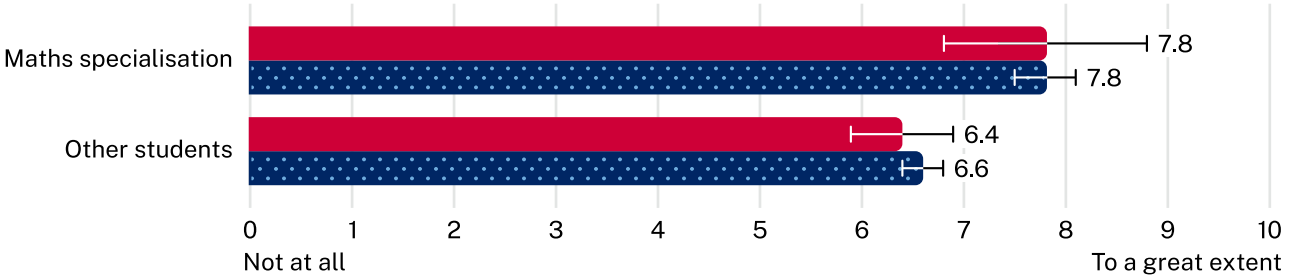
Figure 2

ITE students' average ratings of their interest and proficiency in mathematics

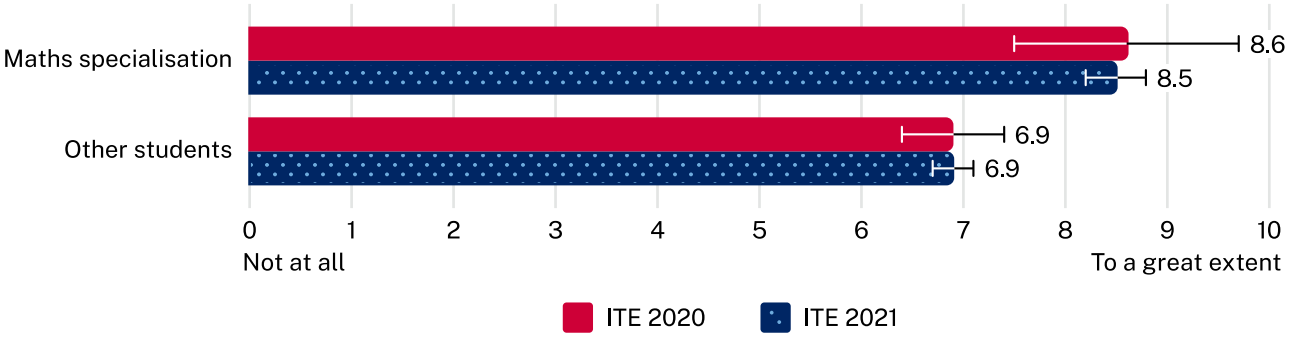
2.1 Answers to the question 'I like teaching mathematics'



2.2 Answers to the question 'I would consider myself to be adept at mathematics'



2.3 Answers to the question 'I enjoy learning mathematics'

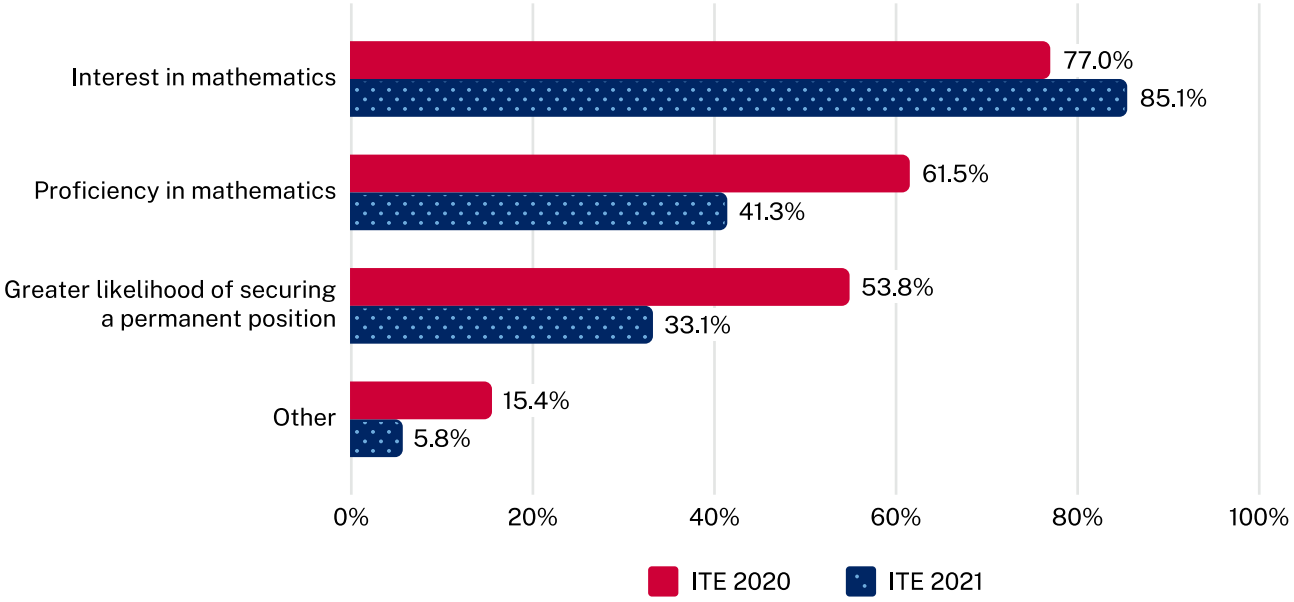


Note: In the 2020 survey, 13 respondents were enrolled in a maths specialisation and 81 respondents were other students. In the 2021 survey, 121 respondents were enrolled in a maths specialisation and 473 respondents were other students.

We asked students their reasons for undertaking a mathematics specialisation (Figure 3). In both 2020 and 2021, an interest in mathematics was the most common reason for students undertaking a mathematics specialisation. However, a higher proportion of students chose this reason in 2021 (85.1%) compared to 2020 (77.0%). Student self-reported proficiency in mathematics (41.3%) and a greater likelihood of securing a permanent position (33.1%) were also prominent reasons for undertaking a mathematics specialisation in 2021.

Figure 3

Reasons that ITE students undertook a mathematics specialisation



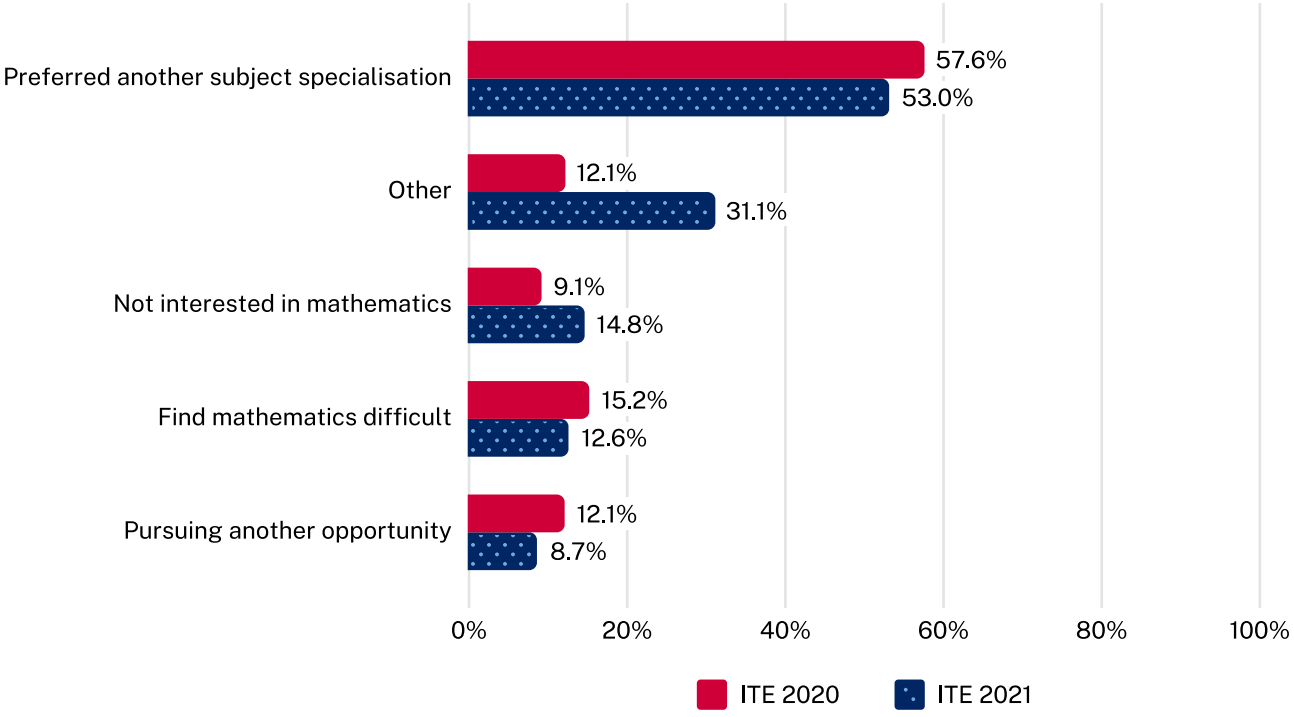
Note: In the 2020 survey there were 13 respondents. In the 2021 survey there were 121 respondents.

As shown in Figure 4, the most frequently reported reason for not enrolling in a maths specialisation was a preference for another subject, given by 53.0% of students in 2021 and 57.6% of students in 2020. Other reasons for not undertaking a mathematics specialisation included disinterest in mathematics and the difficulty of the subject.

Apart from a preference for another subject specialisation, 31.1% of students in 2021 indicated 'other' reasons for not undertaking a mathematics specialisation. Analysis of these open-text responses indicates the most common reasons were that the NESA-recognised mathematics specialisation was not available in their degree, and that their previous study gave them advanced standing in another specialisation. It was also reported that there was a lack of clarity about whether they were eligible to enrol in a mathematics specialisation.

Figure 4

Reasons that ITE students did not undertake a mathematics specialisation



Note: In the 2020 survey there were 33 respondents. In the 2021 survey there were 183 respondents.

The mathematics specialisation was reported to be appropriately and coherently structured

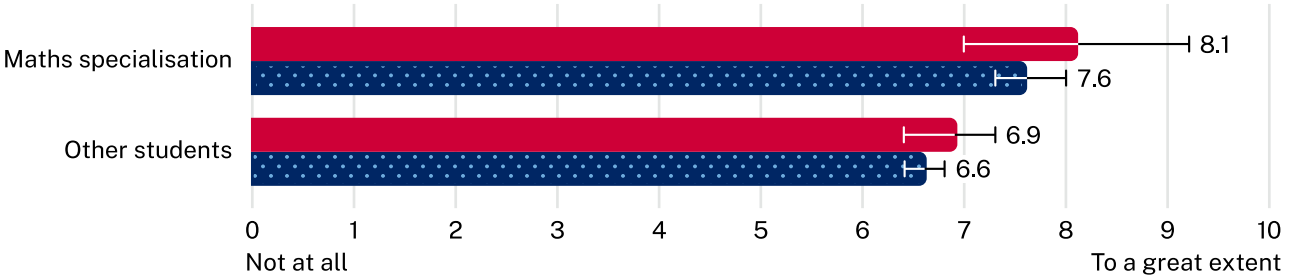
This evaluation gathered information to understand ITE students' perceptions of their initial teacher education programs and whether they felt these programs were effective at teaching mathematics pedagogy. We asked survey respondents to rate the extent to which their primary teaching degrees focused on specific strands of the mathematics syllabus. Across both survey waves, students undertaking a mathematics specialisation reported that their degrees placed greater focus on all 3 syllabus strands (Figure 5). The greatest difference between the ratings of the 2 groups of students can be seen in the number and algebra strand.

The lower ratings for the statistics and probability strand is expected, as NESA limits the number of statistics units that can be counted towards a mathematics specialisation. Of the 6 required mathematics units, only one unit of statistics is permitted (NSW Education Standards Authority 2018).

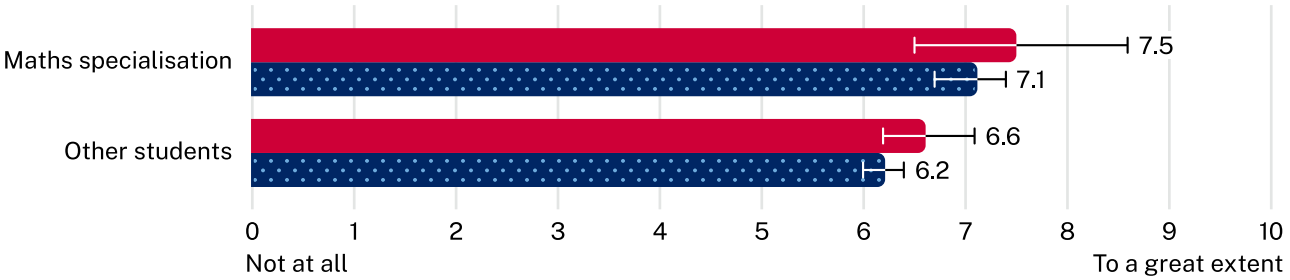
Figure 5

ITE students' average ratings of how strongly their degrees focused on different mathematics syllabus strands

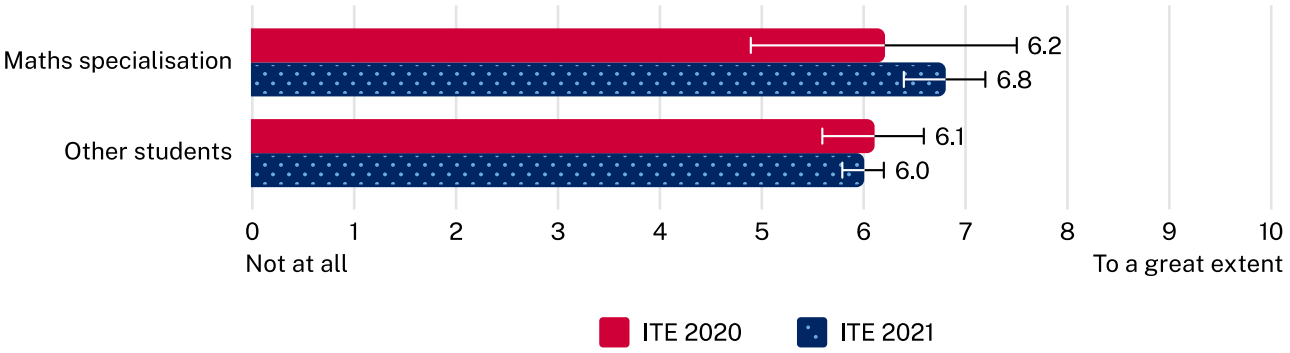
5.1 Answers to the question 'there was a strong focus on number and algebra'



5.2 Answers to the question 'there was a strong focus on measurement and geometry'



5.3 Answers to the question 'there was a strong focus on statistics and probability'



Note: In the 2020 survey, 13 respondents were enrolled in a maths specialisation and 81 respondents were other students. In the 2021 survey, 121 respondents were enrolled in a maths specialisation and 473 respondents were other students.

We asked students to rate how strongly their primary teaching degrees focused on various mathematics pedagogical topics (Figure 6). The 8 mathematics pedagogy topics we reference are sourced from the Teacher Education and Development Study in Mathematics (TEDS-M). TEDS-M was an international study of teacher education programs for primary and secondary mathematics, which included identifying pedagogical topics that were part of these programs (Tatto 2013). Table 3 below lays out the full definition of the TEDS-M pedagogical topics from Figure 6, which are labelled 1 to 8.

Table 3

Key and definitions of TEDS-M mathematics pedagogy topics

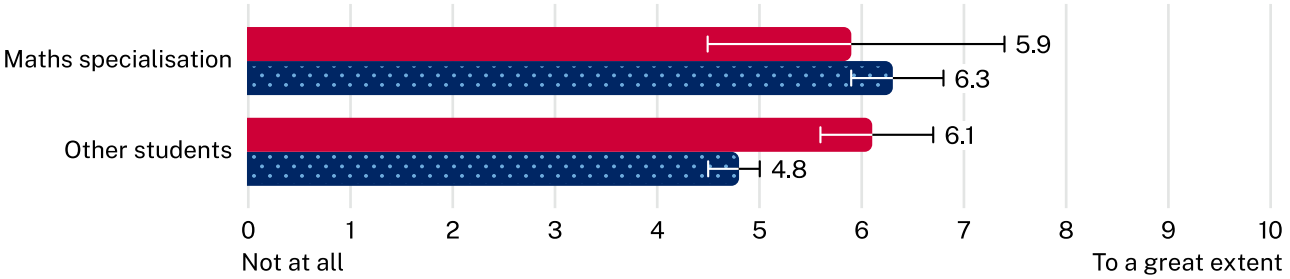
Topic	Definition
1	Affective issues in mathematics (for example, beliefs, attitudes, mathematics anxiety)
2	Mathematics standards and curriculum
3	Mathematics teaching, observation, analysis and reflection
4	Developing teaching plans (for example, selecting and sequencing the mathematics content, studying and selecting textbooks and instructional materials)
5	Mathematics instruction (for example, representation of mathematics content and concepts, teaching methods, analysis of mathematical problems and solutions, problem-posing strategies, teacher-student interaction)
6	Development of mathematics ability and thinking (for example, theories of mathematics ability and thinking, developing mathematical concepts, reasoning, argumentation and proving, abstracting and generalising, carrying out procedures and algorithm, application, modelling)
7	Context of mathematics education (for example, role of mathematics in society, gender/ ethnic aspects of mathematics achievement)
8	Foundations of mathematics (for example, mathematics and philosophy, mathematics epistemology, history of mathematics)

In both 2020 and 2021, students undertaking a NESA mathematics specialisation reported on average that their degrees had a greater focus on the mathematics pedagogy topics described by TEDS-M than non-mathematics specialisation students. Figure 6 also shows that ‘Mathematics standards and curriculum’, ‘Mathematics instruction’ and ‘Development of mathematics ability and thinking’ are the most frequently reported components of most initial teacher education primary education degrees. Across the board, ratings for ‘Affective issues in mathematics’ and ‘Foundations of mathematics’ are lower.

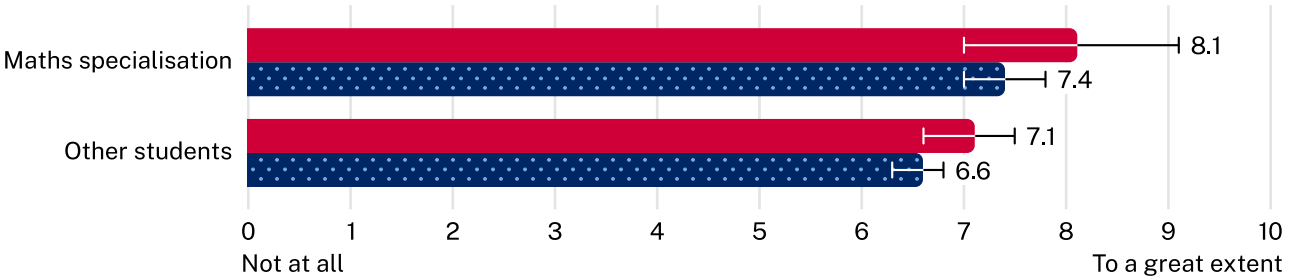
Figure 6

ITE students' average ratings of how strongly their degrees focused on the mathematics pedagogy topics described by TEDS-M

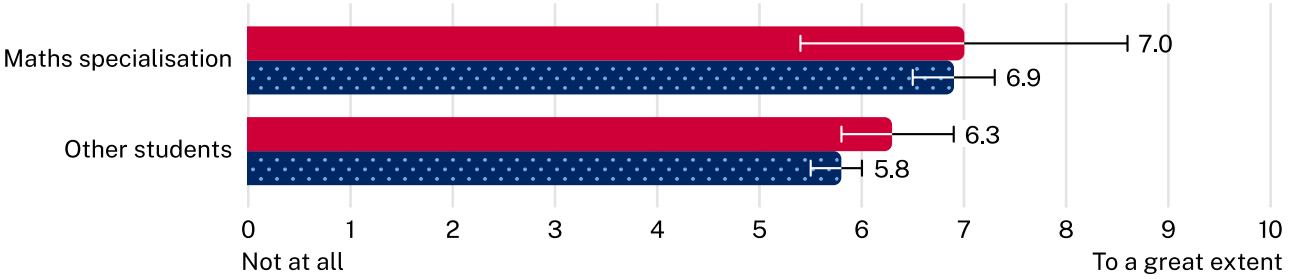
6.1 Answers to the question 'there was a focus on affective issues in mathematics'



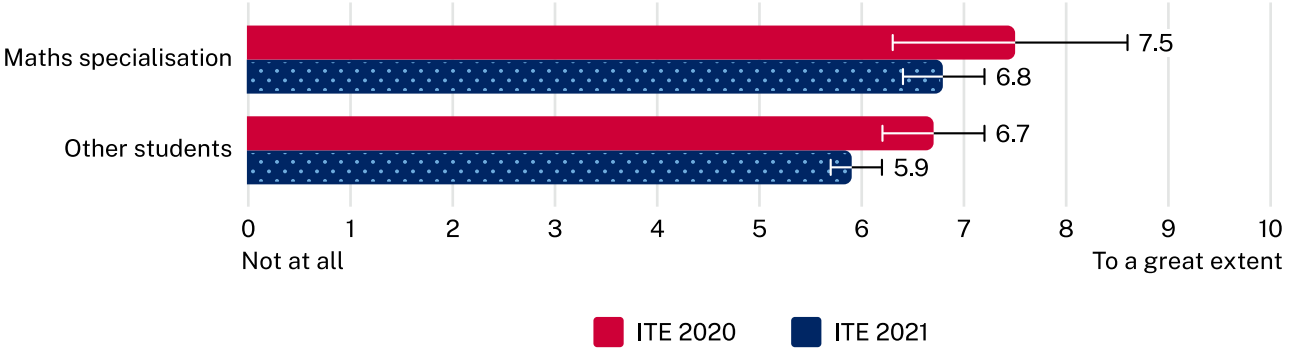
6.2 Answers to the question 'there was a focus on mathematics standards and curriculum'



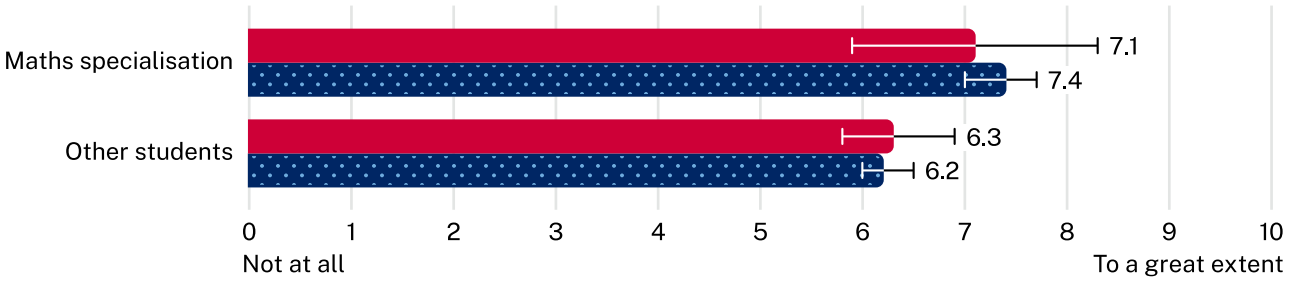
6.3 Answers to the question 'there was a focus on mathematics teaching, observation, analysis and reflection'



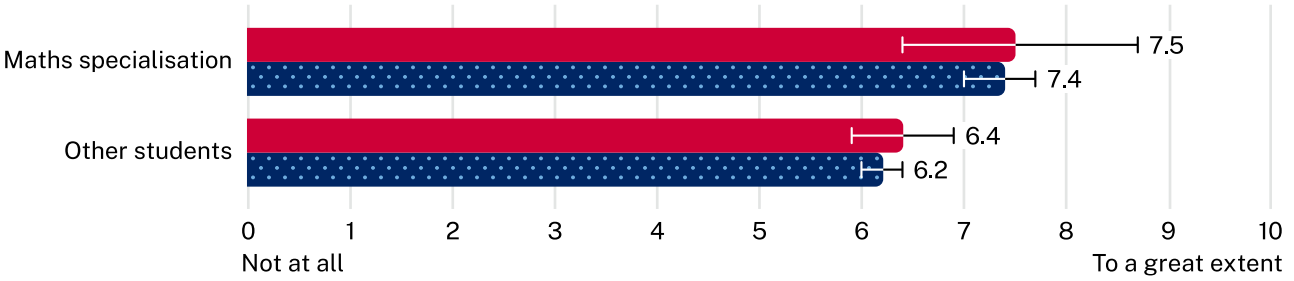
6.4 Answers to the question 'there was a focus on developing teaching plans'



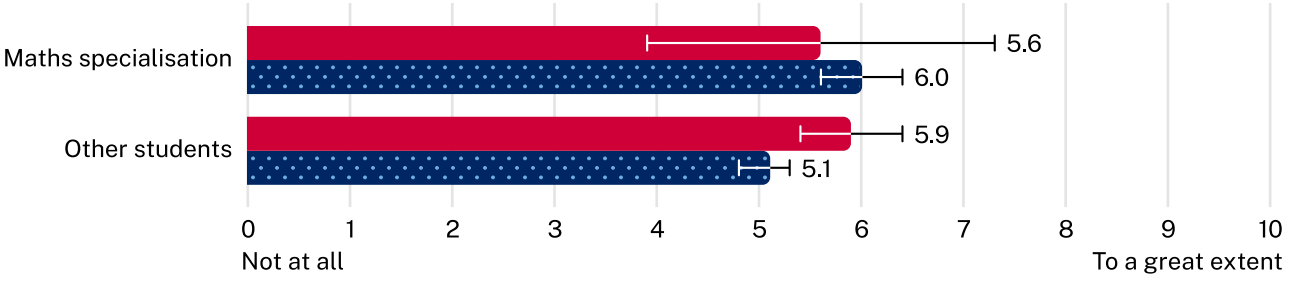
6.5 Answers to the question 'there was a focus on mathematics instruction'



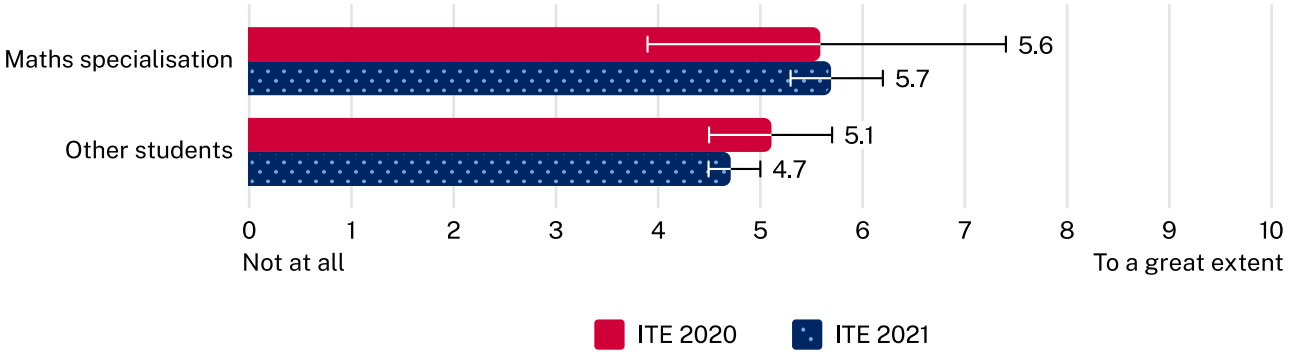
6.6 Answers to the question 'there was a focus on development of mathematics ability and thinking'



6.7 Answers to the question 'there was a focus on context of measurement education'



6.8 Answers to the question 'there was a focus on foundation of mathematics'



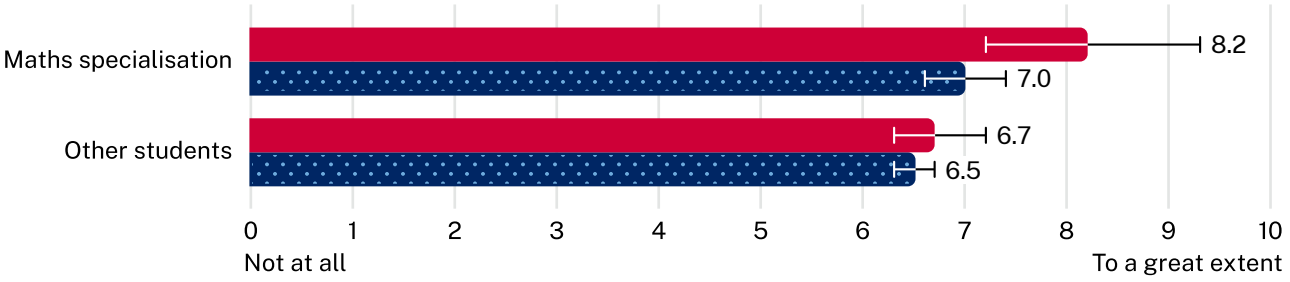
Note: In the 2020 survey, 13 respondents were enrolled in a maths specialisation and 81 respondents were other students. In the 2021 survey, 121 respondents were enrolled in a maths specialisation and 473 respondents were other students.

Students were asked to rate the coherency and structure of their primary teaching degrees against a group of 6 statements (Figure 7). Students undertaking a mathematics specialisation reported slightly stronger agreement with the statements. The greatest difference between the ratings of mathematics specialisation students and non-mathematics specialisation students is seen in responses to statement 5, 'Later subjects in the program build on what was taught in earlier subjects in the program'. In 2021, mathematics specialisation students reported an average rating of 7.2, while non-mathematics specialisation students reported an average rating of 6.2.

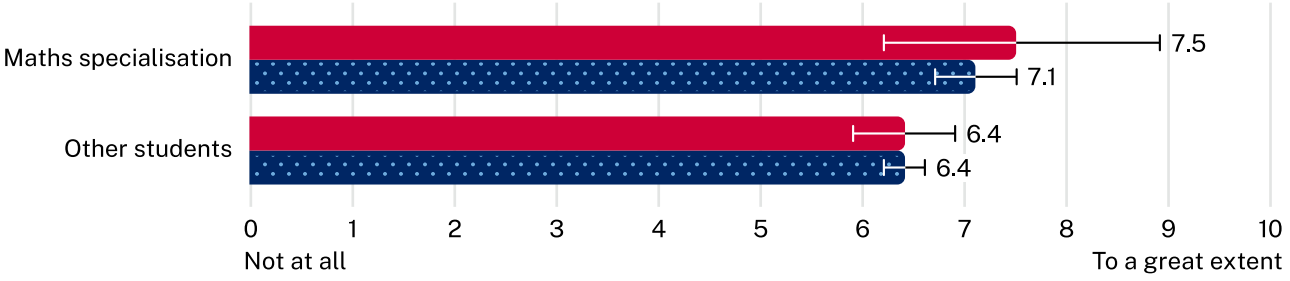
Figure 7

ITE students' average ratings of the coherency of their primary teaching degrees

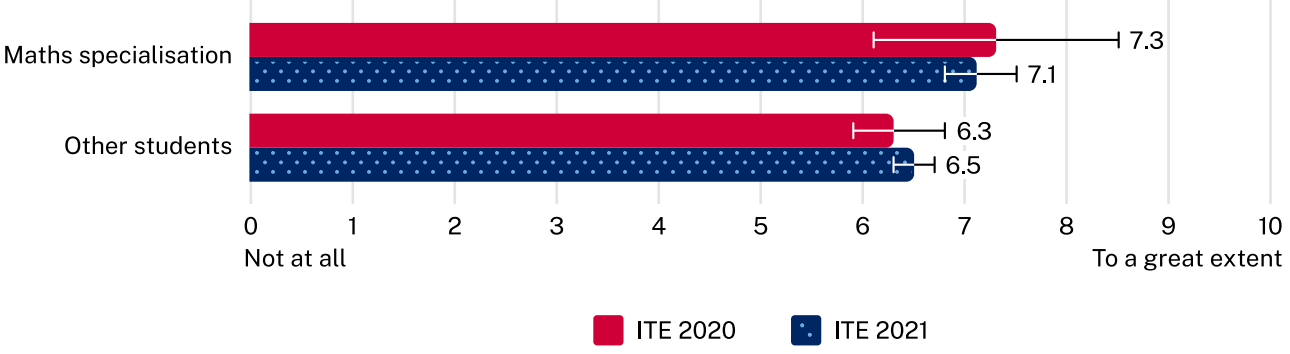
7.1 Answers to the question 'there were clear links between most of the subjects in my teacher education program'



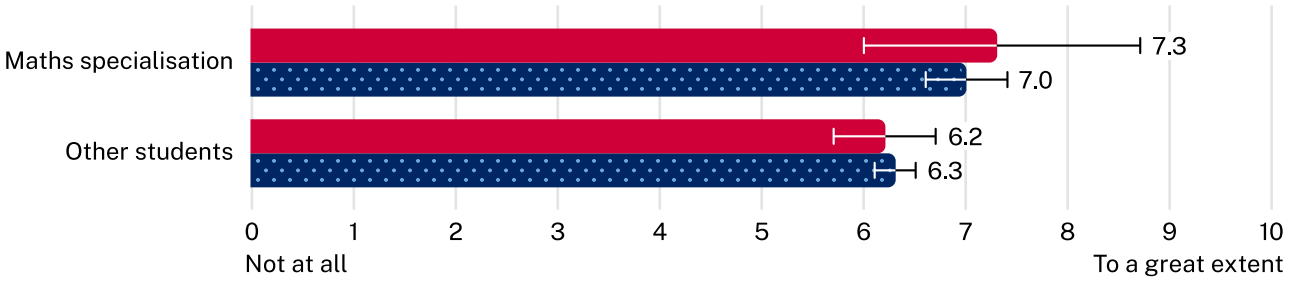
7.2 Answers to the question 'each of my subjects was clearly designed to prepare me to meet a common set of explicit standard expectations for beginning teachers'



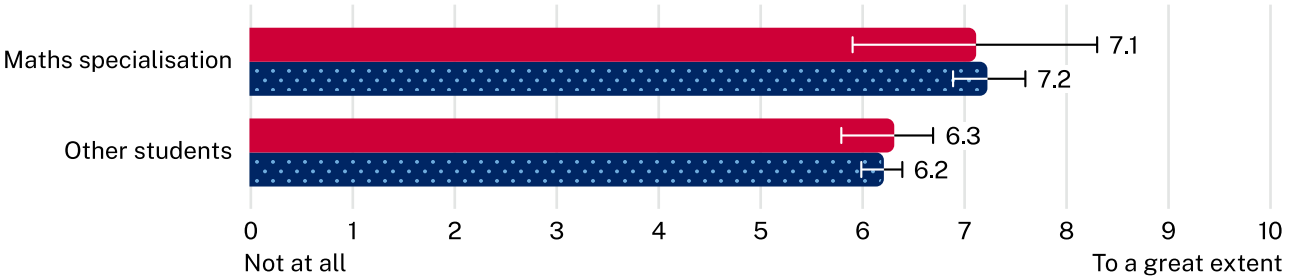
7.3 Answers to the question 'the subjects seemed to follow a logical sequence of development in terms of content and topics'



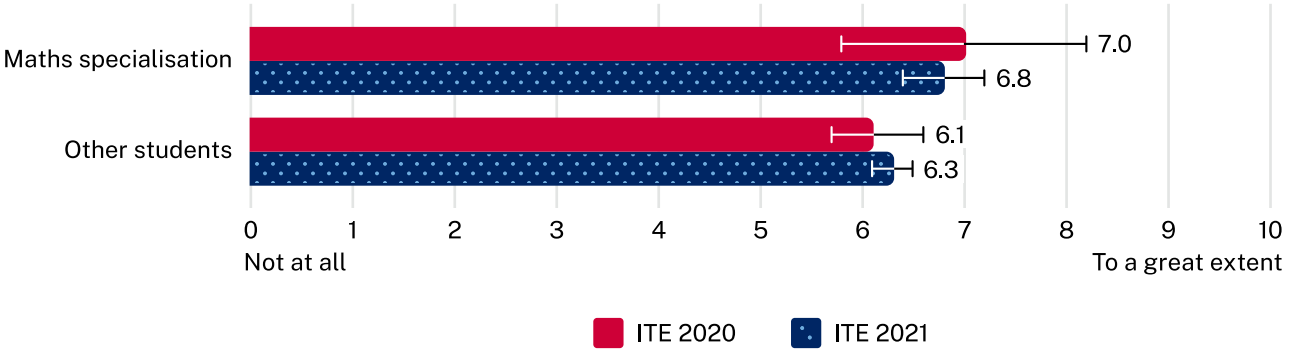
7.4 The program was organized in a way that covered what I needed to learn to become an effective teacher



7.5 Later subjects in the program built on what was taught in earlier subjects in the program



7.6 Each stage of the program seemed to be planned to meet the main needs I had at that stage of my preparation



Note: In the 2020 survey, 13 respondents were enrolled in a maths specialisation and 81 respondents were other students. In the 2021 survey, 121 respondents were enrolled in a maths specialisation and 473 respondents were other students.

Survey respondents were asked to provide suggestions for improvements in the way their degrees were preparing them for primary teaching. Of the 121 respondents undertaking a NESA-recognised mathematics specialisation, 41 provided additional suggestions. These responses were analysed for prominent themes. The most frequently reported suggestions for improvements in the primary mathematics specialisations included suggestions of more practical activities and opportunities for practical teaching and learning experiences, and more support to create lesson plans aligned with curriculum content.

During interviews with mathematics specialisation students, we asked about their expectations of studying the specialisation. All 5 students reported that they expected their course to cover a broad range of mathematics content areas. Of these students, 3 indicated that their courses had covered foundational concepts of teaching mathematics, which had expanded their understanding of mathematics pedagogy.

> "These extra education units that are, you know, young children as mathematicians, teaching children numeracy, you know they were all sort of more geared towards educating kids in maths as opposed to just more maths units, which I thought personally was far better."
>
> **Primary mathematics specialisation student, University of New England**

> "I had thought that I would be learning a lot more content and what to teach, whereas … it's more, how to teach it, how to offer rich tasks, making sure that our foundational skills are, I guess, up to scratch, so that we have a really solid understanding of the foundation and then how we can make that flexible for all learners, I suppose. So it was, it's a lot more, it's far broader than I would have ever imagined."
>
> **Primary mathematics specialisation student, University of Newcastle**

These comments suggest that students undertaking the mathematics specialisations at the University of New England and the University of Newcastle engage with pedagogical concepts on a foundational level which has influenced students' understanding of teaching mathematics.

We also asked the mathematics specialisation students about the expectations they had about their specialisation when they began teaching. There were 3 students who believed their specialisation would mean they could make meaningful contributions to planning and programming.

> "My understanding is that maybe if I was in say a bigger school, for example, I might be part of like the maths KLA team and they kind of focus heavily on the school-wide planning, or at least within stages."
>
> **Primary mathematics specialisation student, University of Newcastle**

Another 3 students indicated that they hoped their mathematics specialisation would increase their opportunities for employment. In addition, 3 students also specifically mentioned that their specialisation might help them become a maths specialist within their school at some point.

> "I know some schools do have maths specialists, and that's where I felt potentially, I would have more of an opportunity to be considered for those roles [in future]. Sometimes teachers find maths an intimidating subject. So if I could specialise, then maybe it just might make me a more attractive candidate for a job."
>
> **Primary mathematics specialisation student, University of New England**

Some of the interviewed students felt the university mathematics courses were not necessary to teach mathematics required by the NSW mathematics syllabus in primary school.

> "The prerequisite maths subjects that I had to do, the maths 100 and the stat 100. … If you're going to do a science degree, you would do those units. But for a primary school teacher, I think those units were a waste of my time. … I think having prerequisites like that are a waste of time."
>
> **Primary mathematics specialisation student, University of New England**

ITE university coordinators have seen increased enrolments in the mathematics specialisations

In 2022, we interviewed 10 academics working at universities that were offering or had previously offered primary mathematics specialisations. The purpose of these interviews was to gain additional perspectives on the specialisations from the staff who had been implementing them.

The academics commonly stated that the submission process for NESA accreditation of the mathematics specialisations had been straightforward to complete and that the feedback they had received from NESA during the process had been positive. Interviewees discussed the changes they had made to the specialisations during the recent re-accreditation process, which they explained were usually made because of discussion with their colleagues and consideration of their students' feedback.

In the student surveys and interviews, students said that they thought there could be more practical opportunities in their degrees. Some of the interviewed academics discussed challenges in providing these practical experiences, including the impact of COVID-19 on face-to-face teaching opportunities and timetabling of tutorials outside of school hours, which prevented classroom visits. Some practical opportunities academics implemented to address these challenges for specialisation students included online catch-up meetings for students during placement experiences and online peer teaching activities.

Academics from 3 different universities noted the various ways they communicated the availability of the specialisations to students at different points in their degrees which could have contributed to an increase in the number of undergraduates selecting the specialisations. Some common ways of communicating the specialisations to students included providing information about the different specialisations to prospective students before enrolment, promoting the different specialisations in information sessions for the degree they were part of, and discussion of the specialisations in the units the academics were teaching. Academics from 2 universities discussed how their department had a webpage on their learning management system (LMS) available to students that explained the different programs, including the mathematics specialisations, and provided contact details for the program coordinators. There were 3 academics from different universities said that the mathematics specialisations were promoted to students early in their degrees, including orientation sessions, and speculated that students may forget about the specialisations because they receive a lot of information at that time.

A common benefit of the mathematics specialisations noted by academics was the opportunity to develop a rapport with the specialisation students as they had frequent contact with these students through the mathematics units they taught. Of the academics, 2 from different universities also mentioned that the specialisation students were often sought after for employment in schools and that students were aware that completing a mathematics specialisation could benefit their employment prospects.

Half of the interviewed academics, each representing a different university, mentioned the support and opportunities offered to the specialisation students. These ranged from invitations to professional learning and networking events with other mathematics educators (including academic staff and PhD researchers), to outreach programs where students learned about teaching mathematics from an Aboriginal perspective, from Aboriginal educators. Another support mentioned was casual teaching opportunities in after-school programs. One university also organised mentors who would visit specialisation students on their professional experience placements, although this had recently become a challenge to provide because of the increasing number of specialisation students at that university.

The interviews included mentions of support that could be provided to university staff from the department and NESA. Overall, the interviewees were satisfied with the support available from the department and NESA and did not have specific requests for support. However, some interviewees suggested that there could be more communication from the department and NESA to principals about the specialisations so that principals would be more aware of the specialised skill sets and experience of these graduates.

There is an increasing number of mathematics specialisation graduates in NSW public schools

As of December 2021 there were 241 accredited primary teachers with a NESA mathematics specialisation, with the number of per-year accreditations increasing steadily over time. The implementation of the mathematics specialisations at other institutions is likely driving the increasing number of per-year specialist graduate accreditations. Table 4 below lists the number of students graduating with a NESA-recognised primary mathematics specialisation per year who are also accredited to teach.[2]

Table 4

Number of mathematics-specialised graduates accredited to teach (as of December 2021)

Year of accreditation	Number of graduates accredited to teach per year
2017	16
2018	18
2019	32
2020	73
2021	102

As shown in Table 5, the number of students graduating with a NESA recognised primary mathematics specialisation who have been placed into teaching roles in NSW public schools is increasing. As of October 2022, 68 mathematics-specialised graduates have been placed in NSW public schools. There are 26 graduates who have started teaching in 2022 – the highest annual intake of NESA mathematics specialisation graduates into NSW public primary schools. Despite this, there is a large gap between the number of graduates with NESA mathematics specialisations receiving accreditation and the number of these graduates employed in NSW Government schools. This difference could partly be caused by mathematics specialisation graduates being employed in Catholic and independent schools instead. However, it is unclear if this is the driving force behind this difference.

2 Does not include people who have ceased their accreditation with NESA or who were not accredited by NESA in the first place.

Table 5

Number of mathematics-specialised graduates placed into teaching roles (as of October 2022)

Year of accreditation	Number of graduates accredited to teach per year
2017	8
2018	13
2019	13
2020	8
2021	26

The School Workforce team within the NSW Department of Education has used a variety of strategies to increase the recruitment of graduates from NESA primary mathematics specialisations into NSW public schools. There has also been collaboration between NESA, the department and ITE providers that has enabled the department to identify who the specialisation students are during their final year of studies.

One strategy run by the department has been information sessions for students in the primary mathematics specialisations. These have included webinar sessions and face-to-face sessions run on-campus at the institutions that offer the specialisations. During these sessions, specialisation students were provided with nomination forms to indicate the areas in NSW where they would be interested in taking a permanent position. School Workforce has also been contacting specialisation graduates by phone and communicating opportunities for their employment in department schools.

In 2021 we interviewed graduate teachers with mathematics specialisations who started teaching in 2018 to 2020 and their school principals. At the time, most principals were unaware of the maths specialisations, and it was the responsibility of the graduate teacher to tell their school about the specialisations. We found there was a need for the department to provide information about the specialisations to schools.

School Workforce has developed a quick reference guide to inform department principals about the context and purpose of primary mathematics specialisations. This guide is available on the system that principals use to declare teacher vacancies. This system also allows principals to indicate whether they prefer employing mathematics specialisation teachers, which can help schools meet their specific needs. Additionally, the quick reference guide has been shared through the NSW Primary Principals' Association.

Impact of the specialisations

Do primary teachers with a mathematics specialisation demonstrate greater content and pedagogical knowledge and confidence in teaching mathematics?

In this section of the report, we examine ITE student survey data to understand students' ability to teach mathematics during recent professional experience placements. We also examine interviews with graduate teachers with primary mathematics specialisations to understand how they are using their specialisations in their schools.

Key findings

- Students undertaking a primary mathematics specialisation were able to apply their mathematics knowledge more readily while on professional placements.
- Graduate primary teachers with a mathematics specialisation are using their mathematics knowledge inside their classrooms.

Mathematics specialisation students more readily applied their knowledge on placements

We asked ITE students to rate the extent to which they applied their mathematics knowledge in different contexts during their most recent professional experience placement in a school (Figures 8.1 to 8.3). These questions only applied to survey respondents who had been on at least one placement.

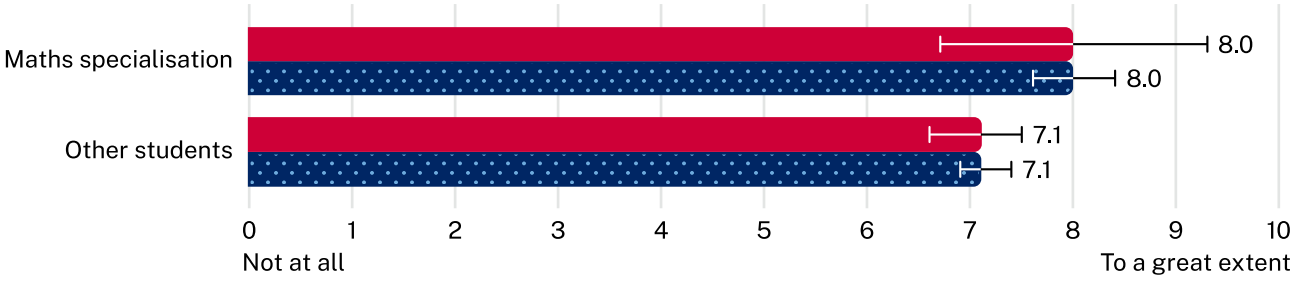
Across both the 2020 and 2021 survey waves, students' reporting of the extent to which they 'applied mathematics knowledge in teaching' while on placements was greater than the items relating to contributions during stage meetings and to whole-school activities. This could reflect students' relatively restricted opportunities to contribute to wider planning and programming activities while on placement.

Mathematics specialisation students' reporting of the extent to which they both 'applied mathematics knowledge by contributing to stage meetings' (6.3) and 'applied mathematics knowledge to whole-school activities' (4.8) was higher than that of non-mathematics specialisation students (5.5 and 4.2 respectively).

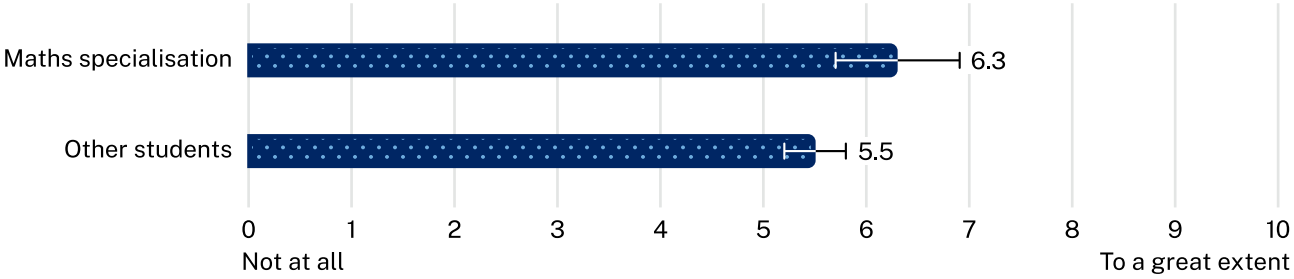
Figure 8

ITE students' average ratings of their application of mathematics knowledge during their professional experience placements

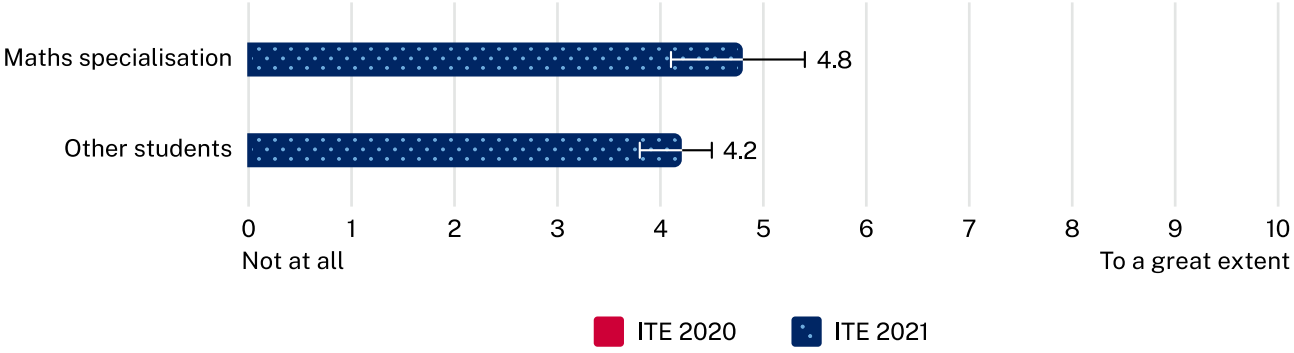
8.1 Answers to the question 'applying your mathematics knowledge in teaching'



8.2 Answers to the question 'applying your mathematics knowledge by contributing ideas to stage meetings/discussions'



8.3 Answers to the question 'applying your mathematics knowledge in whole school activities (for example, mathematics club)'



Note: In the 2020 survey, 13 respondents were enrolled in a maths specialisation and 81 respondents were other students. In the 2021 survey, 121 respondents were enrolled in a maths specialisation and 473 respondents were other students. Questions 2 and 3 were only asked in the 2021 survey.

While we were unable to estimate the effect of the mathematics specialisations on students' ratings of their mathematical knowledge, this trend could suggest that students undertaking the primary mathematics specialisations may have more confidence in their mathematics content knowledge and abilities. We also investigated the relationship between students' responses to the above items and the number of professional experience placements they had completed. We found that all students' ratings of their ability to apply knowledge were higher when they had completed more than one placement.

Graduates are using the knowledge acquired in their mathematics specialisation in their own classrooms

In 2021 we interviewed graduate primary teachers with mathematics specialisations, as well as their supervisors and school principals. These teachers reported using their mathematics knowledge in their own classrooms and sometimes more broadly within their schools. All the teachers we interviewed reported applying the mathematics theory, resources and strategies they learnt as part of their specialisation in their own classrooms. They were able to demonstrate ways they used their maths knowledge, such as differentiating mathematics activities, and targeting common misconceptions in mathematics that students have. Many also reported sharing their maths knowledge with other teachers via collaborative planning sessions – for example, writing maths programs with their stage.

> "I was introduced to these [resources] through the specialisation at university and they've been a massive influence in terms of how I teach maths in the classroom. The idea is low floor high ceiling, to make tasks very accessible to students. … And I think the biggest influence is potentially creating more open-ended and accessible tasks that allow all students to be doing the same thing, but at different levels of understanding."
>
> **Second-year teacher with a mathematics specialisation**

However, teachers reported that they did not have as many opportunities to use their mathematics specialisation outside of their usual practice as beginning teachers in their first year. We found that some of the teachers in their third or fourth year of teaching were starting to be recognised within their school as someone with a maths specialisation. This suggests that teachers need to build confidence in their own teaching practice before they can use their specialisation outside of their own classroom.

Teachers' ability to share their maths knowledge also depended on whether they were supported to do so within their school, either by their supervisor or a maths team, or whether there was a need in the school for maths expertise. A small number of teachers who were recognised in their school as someone with a mathematics specialisation had been able to share their maths knowledge beyond their usual practice. For example, teachers reported joining and leading mathematics committees in their school where they had the opportunity to collaborate with and support other teachers. Some teachers also had the opportunity to share the professional learning they attended with their stage team.

> "We were a school who had been using maths textbooks for quite a number of years … but we wanted to have a deeper knowledge and a better teaching and learning program. … And it was beautiful to have [the specialised teacher] there because she came in with knowledge that worked within a mathematics team to lead and to drive that massive change. And it has now formed part of our strategic improvement plan for the next 4 years …"
>
> **Principal of a third-year teacher with a mathematics specialisation**

While we could not find any evidence that maths specialisation graduates had greater mathematics knowledge and confidence to teach maths compared to other graduates, some principals and supervisors acknowledged that their graduate teacher did have strong mathematics knowledge. Most schools were unaware of their teacher's specialisation, which limited the teacher's ability to demonstrate their knowledge of mathematics more broadly in the school. Our findings show promise that, with the right support from their schools and the department, teachers with mathematics specialisations could be useful for improving the teaching of mathematics in their schools. However, it is not realistic to expect first-year teachers to do this.

Conclusions

Have the primary mathematics specialisations been implemented effectively in ITE settings?

The findings from this evaluation suggest that students in initial teacher education degrees have some awareness of the NESA-recognised mathematics specialisations. While many students understood that specialisations were available within primary education degrees, interview data indicates that not all students were aware that the specialisations were NESA-recognised. Interviewed students requested additional information about the benefits of a NESA-recognised specialisation as they were unsure how this choice would position them for future employment.

Survey data suggests that students undertaking the primary mathematics specialisations were motivated to pursue the specialisations due to their interest and self-reported proficiency in mathematics. Mathematics specialisation students also reported higher levels of agreement with statements such as 'I like teaching mathematics' and 'I enjoy learning mathematics'. More than half of students who did not enrol in the mathematics specialisations reported that they preferred other subjects.

Mathematics specialisation students reported that their degree was appropriately and coherently structured. They rated their degrees as having greater focus on mathematics pedagogy topics than non-specialisation students did. These students also, on average, rated their degrees as having greater coherency in aspects such as logical sequencing of content and pedagogy subjects, and preparedness for teaching. This finding is also supported by data collected during interviews with mathematics specialisation students from 2 universities offering the specialisations, who reported engaging with subjects that expanded their knowledge of mathematics pedagogical concepts on a foundational level.

There has been an increase in both the number of universities offering the NESA-recognised specialisations and the number of students selecting the mathematics specialisations. During interviews, initial teacher education course coordinators reported that working with NESA to have their mathematics specialisations approved was straightforward.

Do primary teachers with a mathematics specialisation demonstrate greater content and pedagogical knowledge and confidence in mathematics?

The survey data collected for this evaluation indicates that students undertaking the specialisations were able to apply their mathematics knowledge more readily in their teaching practice while on professional experience placements. This could suggest that mathematics specialisation students may be more prepared and confident in teaching mathematics.

Interview data collected from mathematics specialisation graduates in their first year of teaching revealed that in their teaching practice, they were applying the mathematics content and pedagogy knowledge covered in their mathematics specialisation. With the right support from their school and the department, teachers graduating with a mathematics specialisation could improve mathematics teaching within their schools over time. However, it is not realistic to expect beginning teachers to take on curriculum leadership roles in their first few years of teaching.

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Appendix

ITE Student Survey

The following table presents the characteristics of survey respondents across survey waves in 2020 and 2021.

Table 6

Characteristics of survey respondents

Variable	2020		2021	
	Number of respondents	Percentage of respondents	Number of respondents	Percentage of respondents
Completed survey responses	94	100%	594	100%
What is your gender?				
Male	65	69%	92	16%
Female	29	31%	499	84%
Other	–	–	3	1%
Which institution are you currently studying at?				
Macquarie University	3	3%	3	1%
University of New England	43	46%	106	18%
University of Sydney	24	26%	10	2%
University of Technology Sydney	14	15%	3	1%
University of Notre Dame Australia	5	5%	52	9%
University of Wollongong	5	5%	42	7%
Charles Sturt University	–	–	60	10%
University of Newcastle	–	–	122	21%
Western Sydney University	–	–	195	33%
What type of degree are you studying?				
Bachelor's degree	54	57%	349	59%
Master's degree	2	2%	245	41%
Blank response	38	40%	–	–

Variable	2020		2021	
	Number of respondents	Percentage of respondents	Number of respondents	Percentage of respondents
What stage best describes where you are up to in your degree?				
First year	9	10%	177	30%
Second year	16	17%	155	26%
Third year	26	28%	111	19%
Fourth year	43	46%	151	25%
Has your course progression been interrupted (for example, have you taken a semester off, reduced your study load or repeated a subject)?				
Yes	31	33%	204	34%
No	63	67%	390	66%
What is the highest level of mathematics that you have completed in secondary school?				
Year 10 level	14	15%	104	18%
General mathematics (non-calculus)	37	39%	309	52%
Advanced mathematics (subjects including calculus)	32	34%	126	21%
Non-NSW secondary qualification	5	5%	23	4%
Other	6	6%	32	5%
Are you undertaking a NESA primary specialisation in mathematics?				
Yes	13	28%	121	20%
No	33	72%	473	80%

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